Estimating Compensating Wage Differentials with Endogenous Job Mobility

Kurt Lavetti
Department of Economics
Ohio State University

Ian M. Schmutte
Department of Economics
University of Georgia
schmutte@uga.edu

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What we do:

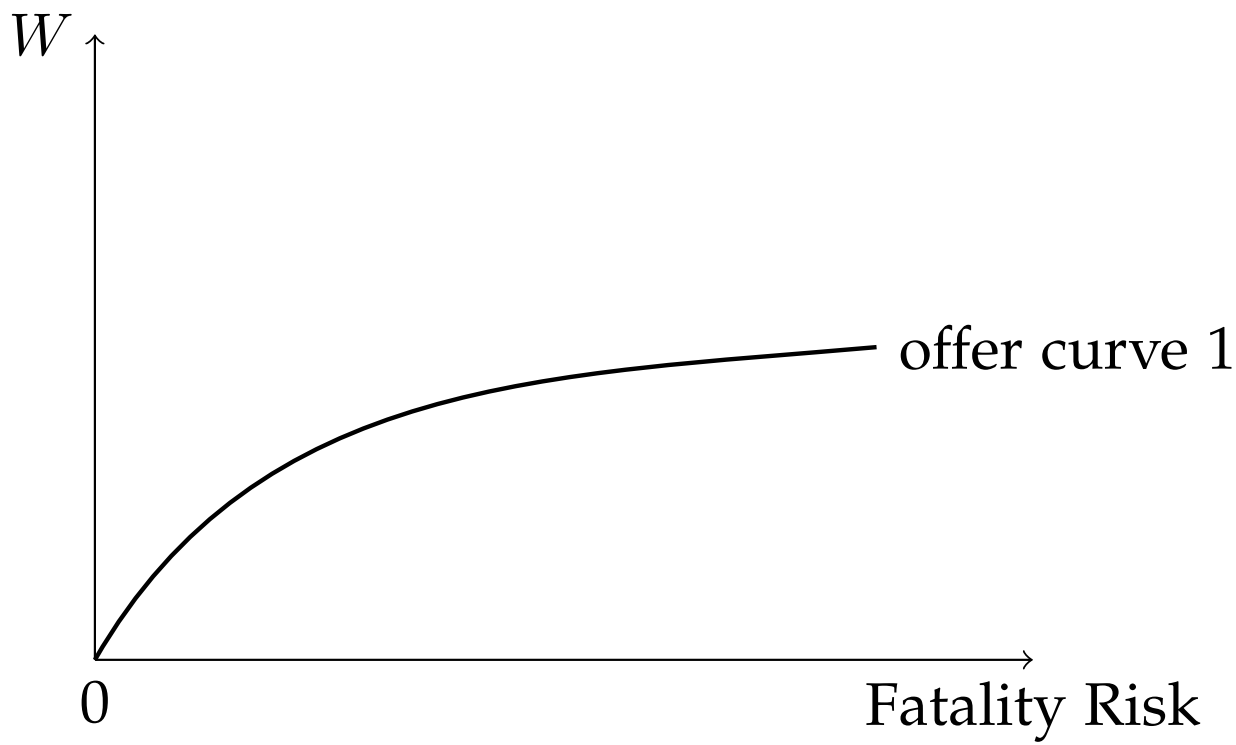
- Estimate compensating wage differentials for fatal injury risk

  Data: Employer-employee matched data from Brazil

- **Issues:**
  - Large disconnect between theory and empirical applications
  - Ability and search frictions may cause severe bias

- **Results:**
  - **Endogenous mobility biases** panel data estimates?
  - Predictions of hedonic search model very consistent with models that control for unobserved employer and job-match heterogeneity
  - Worker preferences for safety can be identified under standard assumptions

Conceptual Framework



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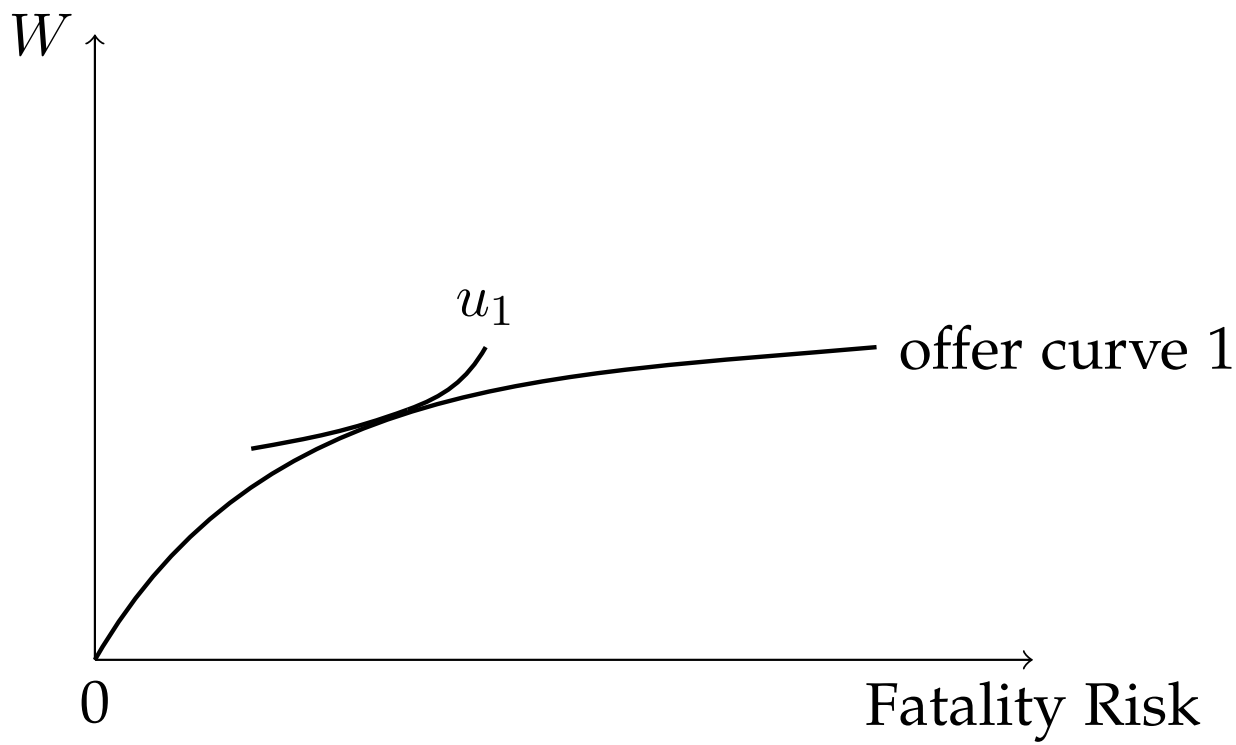

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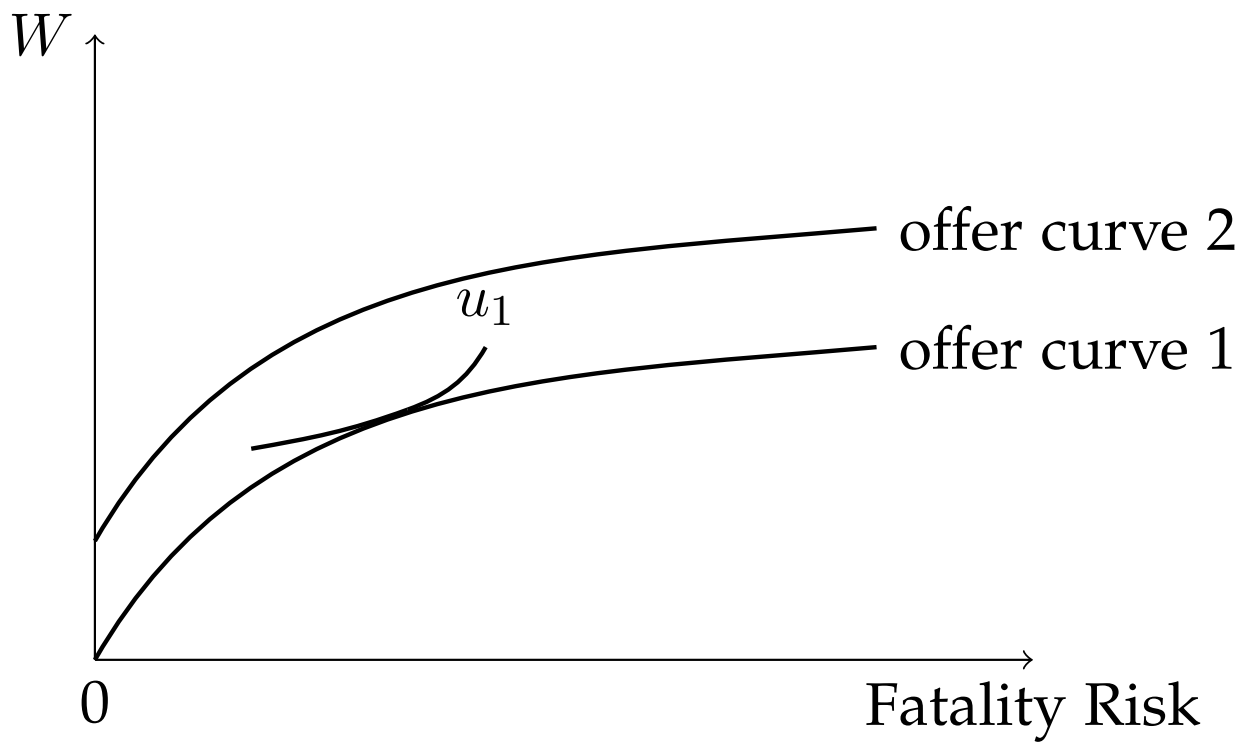

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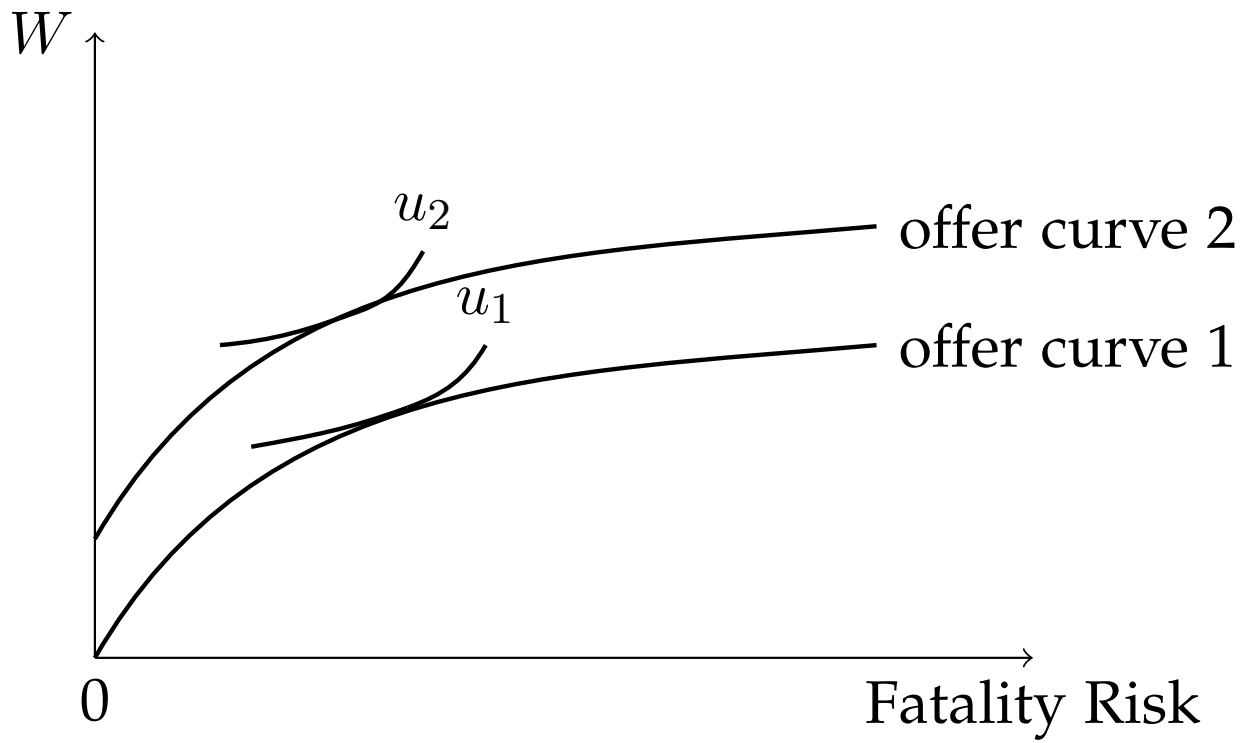

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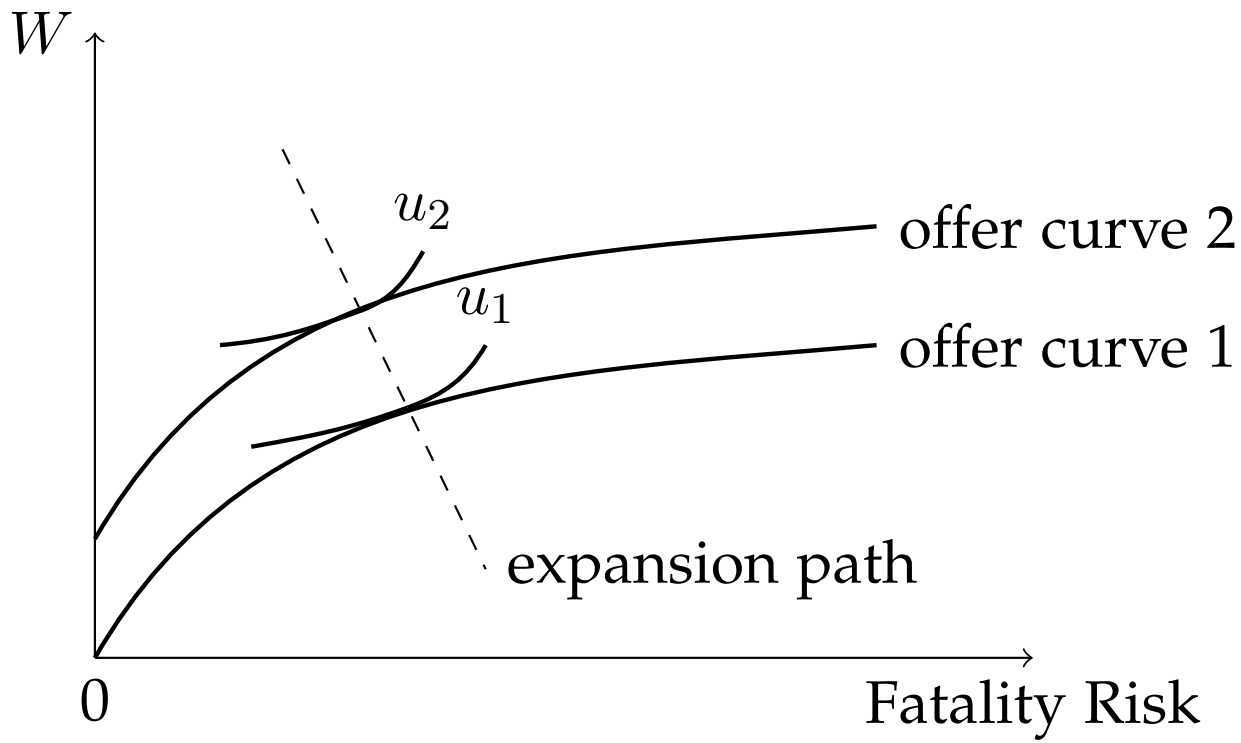
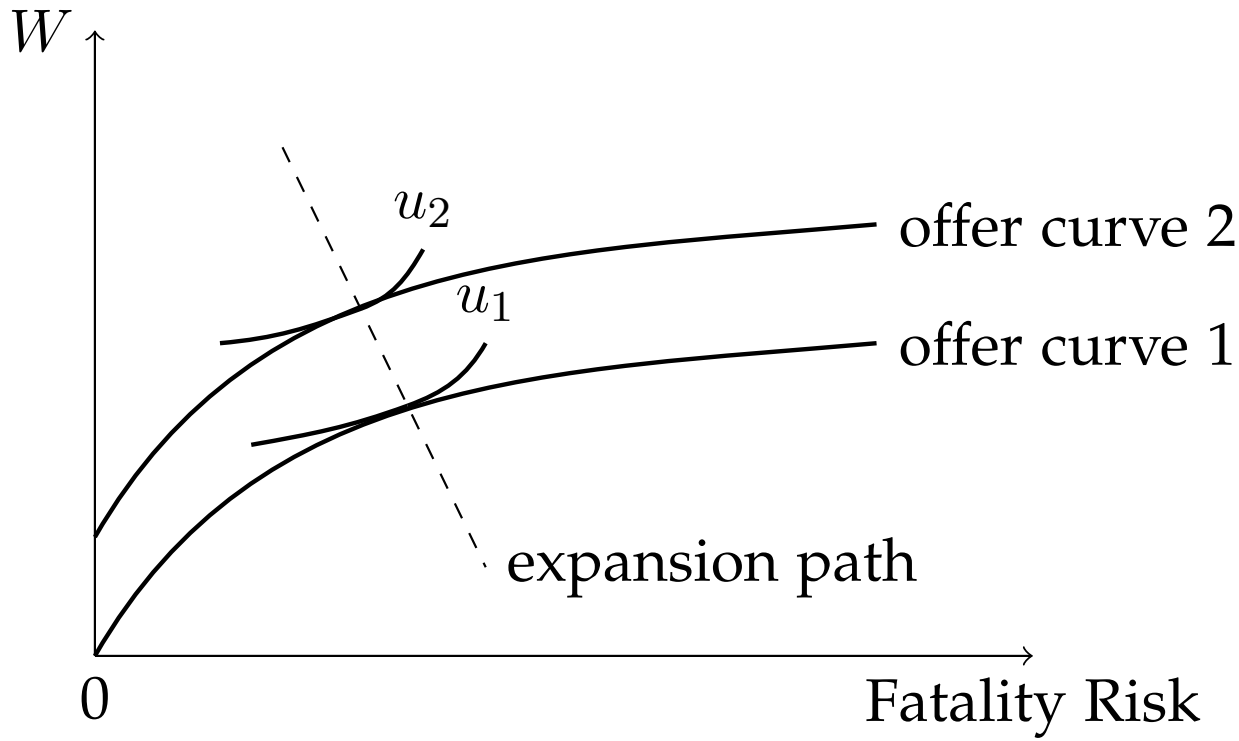


Background: Bias from Unobserved Ability

- Thaler and Rosen (1974)
- Correct cross-sectional estimates
  - Hwang, Hubbard, Reed (1992 *JPE*)

- Panel data
  - Brown (1980)
  - Garen (1988)
  - Kniesner et al. (2012)

Puzzle: Within-worker estimates indicate cross-section estimates are biased *upward*.


W
u_2
u_1
offer curve 2
offer curve 1
expansion path
0
Fatality Risk

Related Literature

- **Structural Partial Equilibrium Approaches**
  - Bonhomme and Jolivet (2009); Dey and Flinn (2008)
  - Villanueva (2007)
  - Sullivan and To (2013;2015)

- **Duration Analysis:** Gronberg and Reed (1994)

- **Matched Data and CWD**
  - Lalive (2003) [Austria]
  - Dale-Olsen (2006) [Norway]
  - Tsai (2011) [Taiwan]

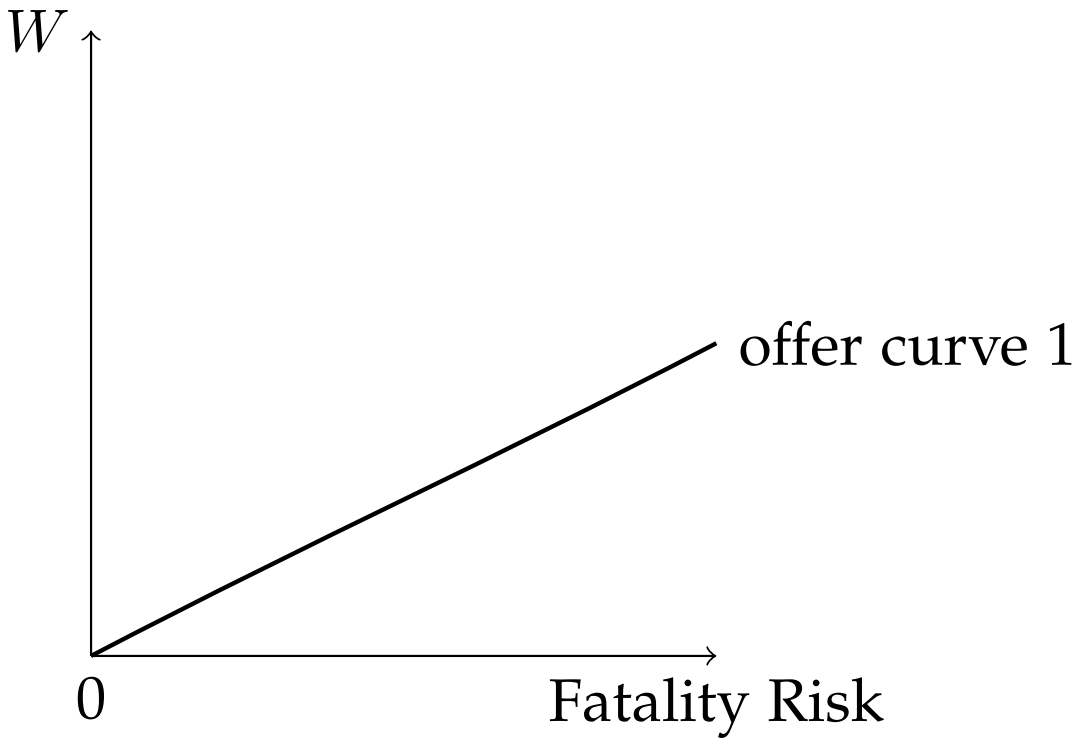
- **Endogenous Mobility**
  - Card, Heining, Kline (2013)
  - Abowd, McKinney, Schmutte (2015)
  - Lavetti (2015)

Intuition Underlying Exogeneity Tests

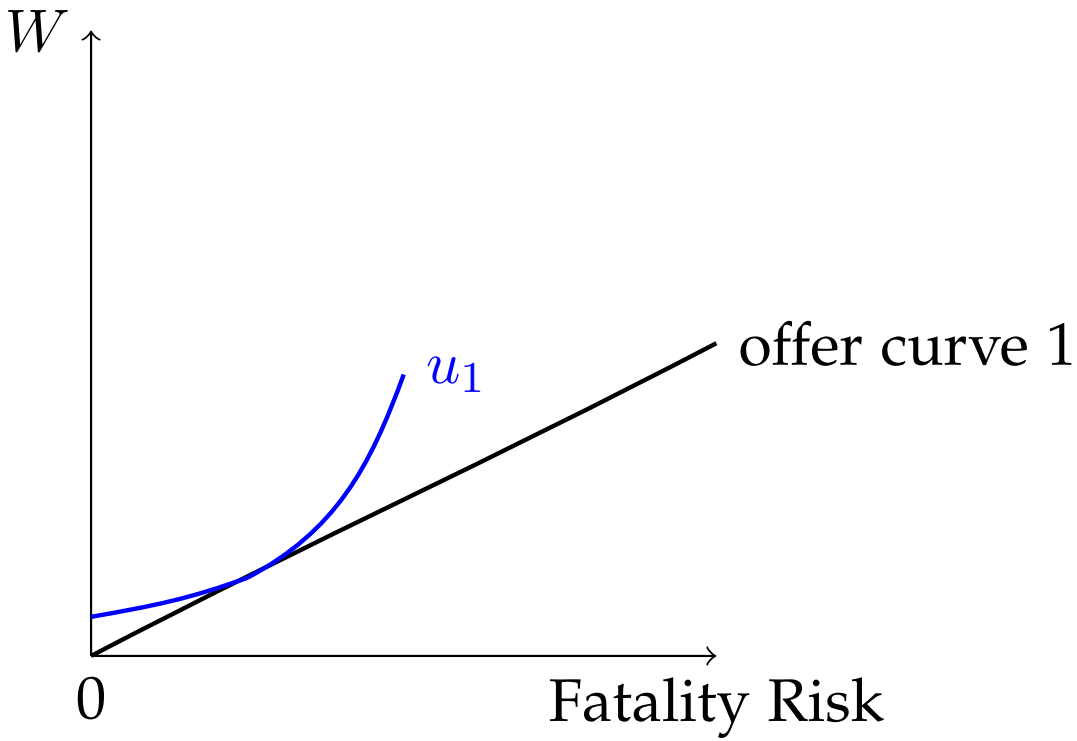
Discontinuous Response

- Caetano (2015): Misspecification diagnosed by discontinuous response at threshold points.
- In our context: Risk ≈ 0

Corner Solutions



Corner Solutions



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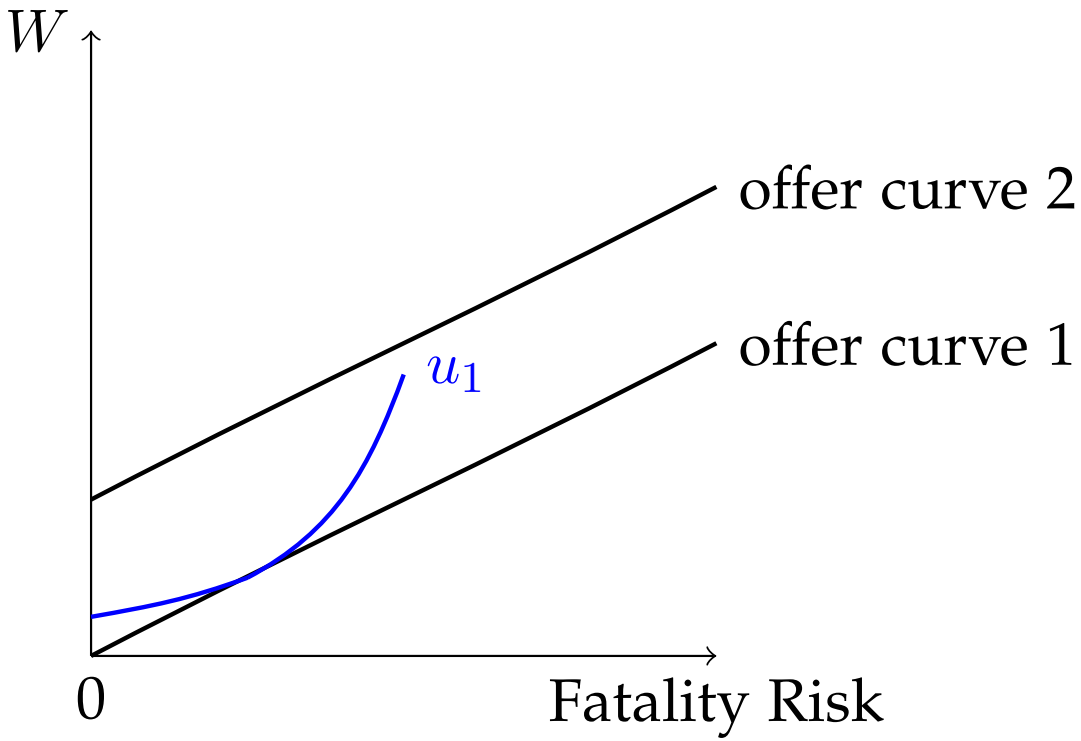

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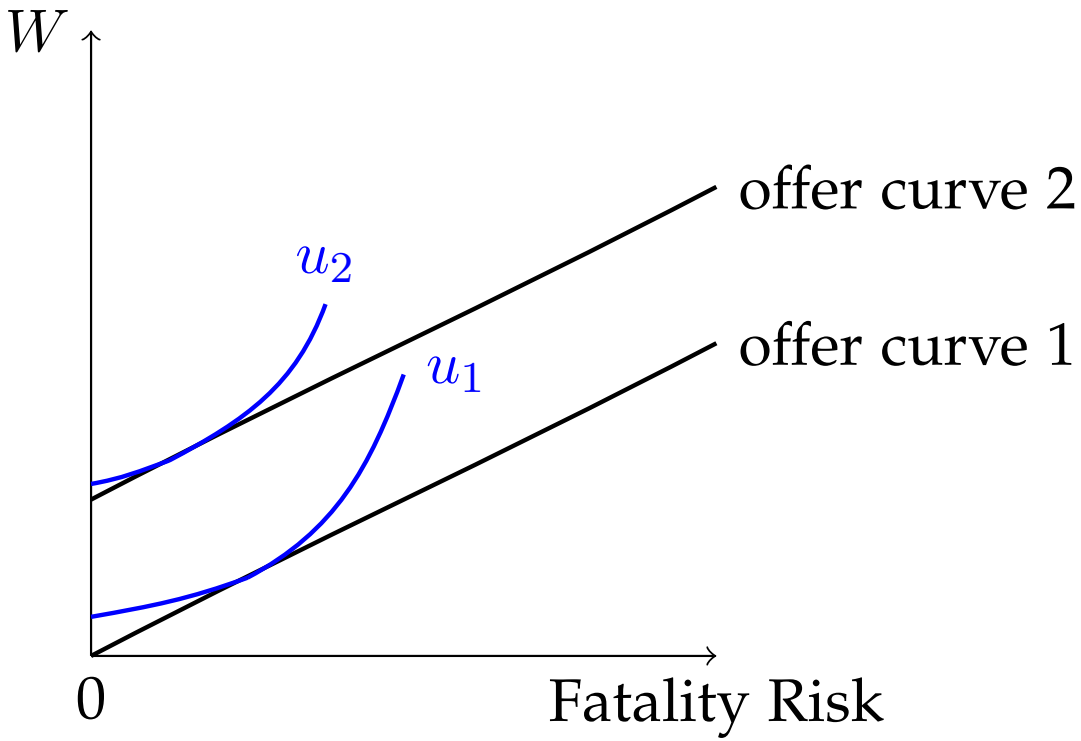

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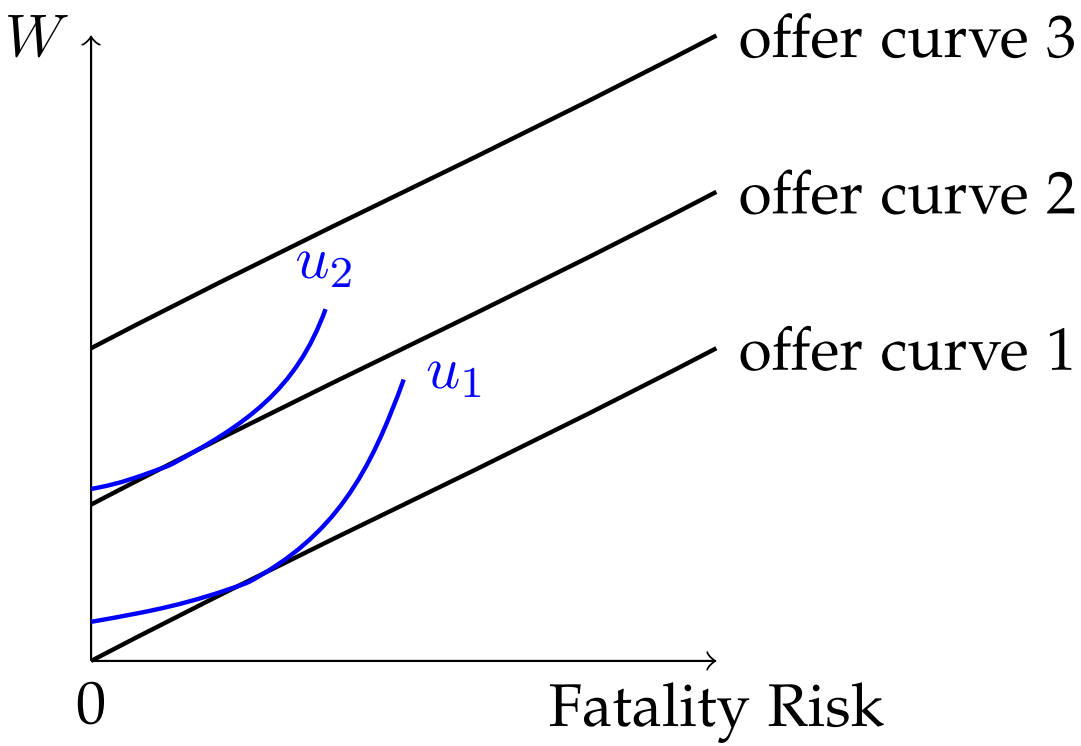

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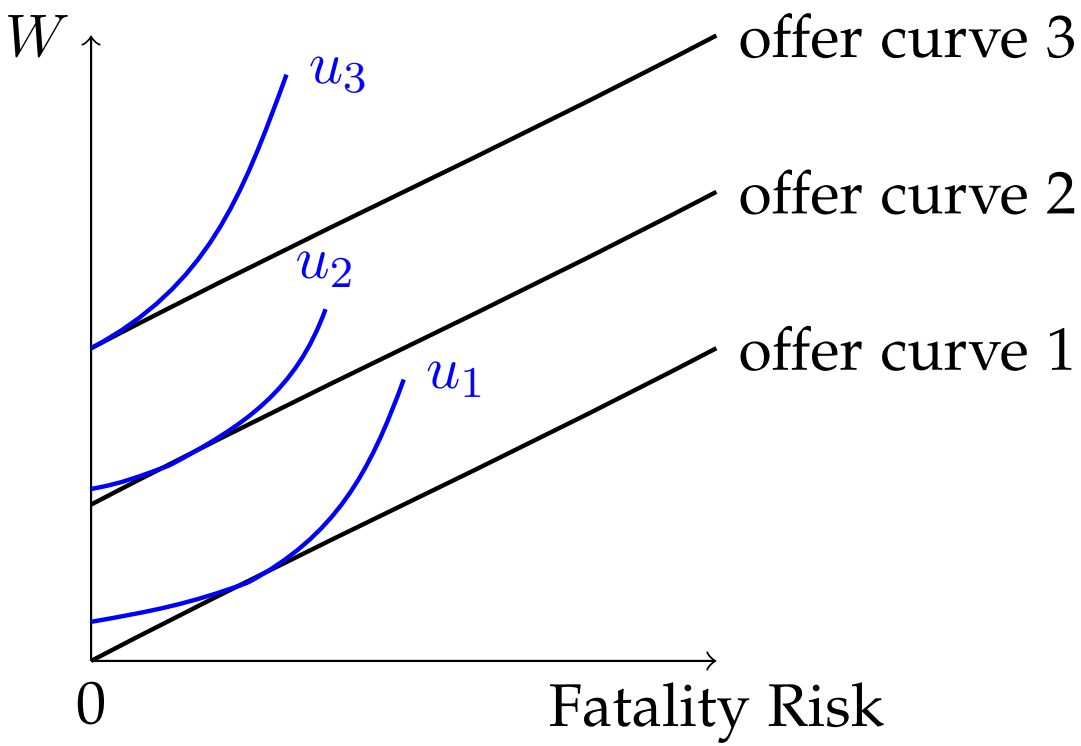

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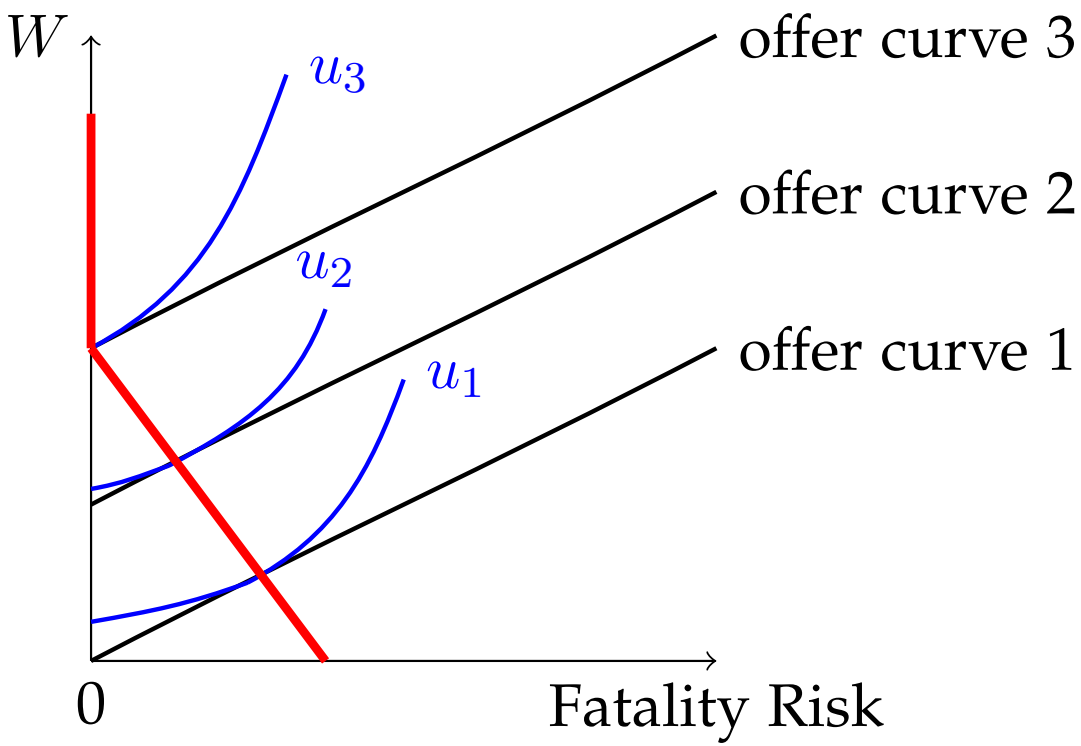
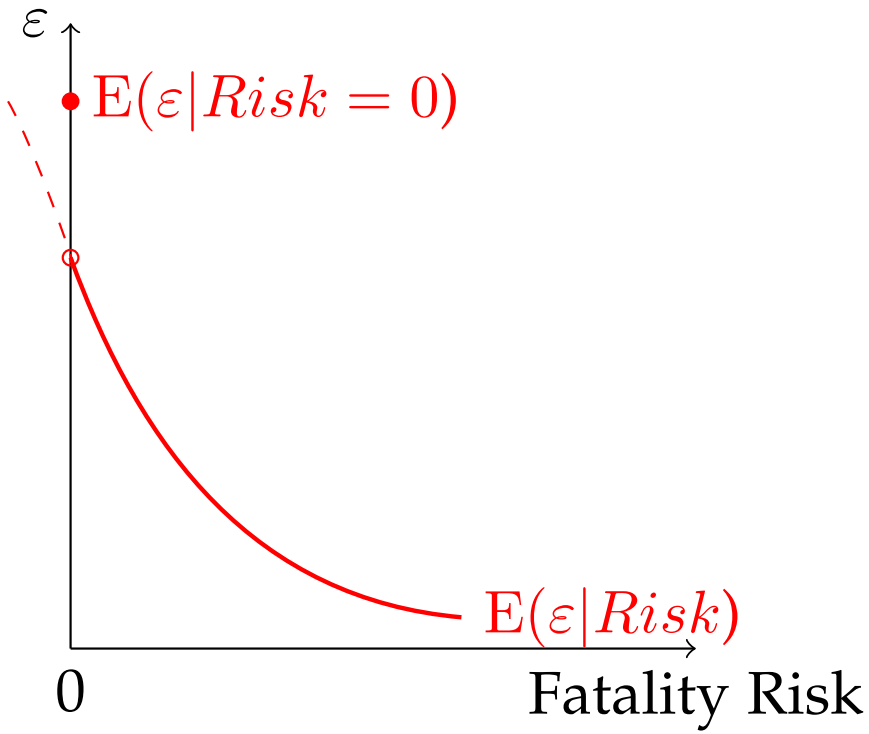
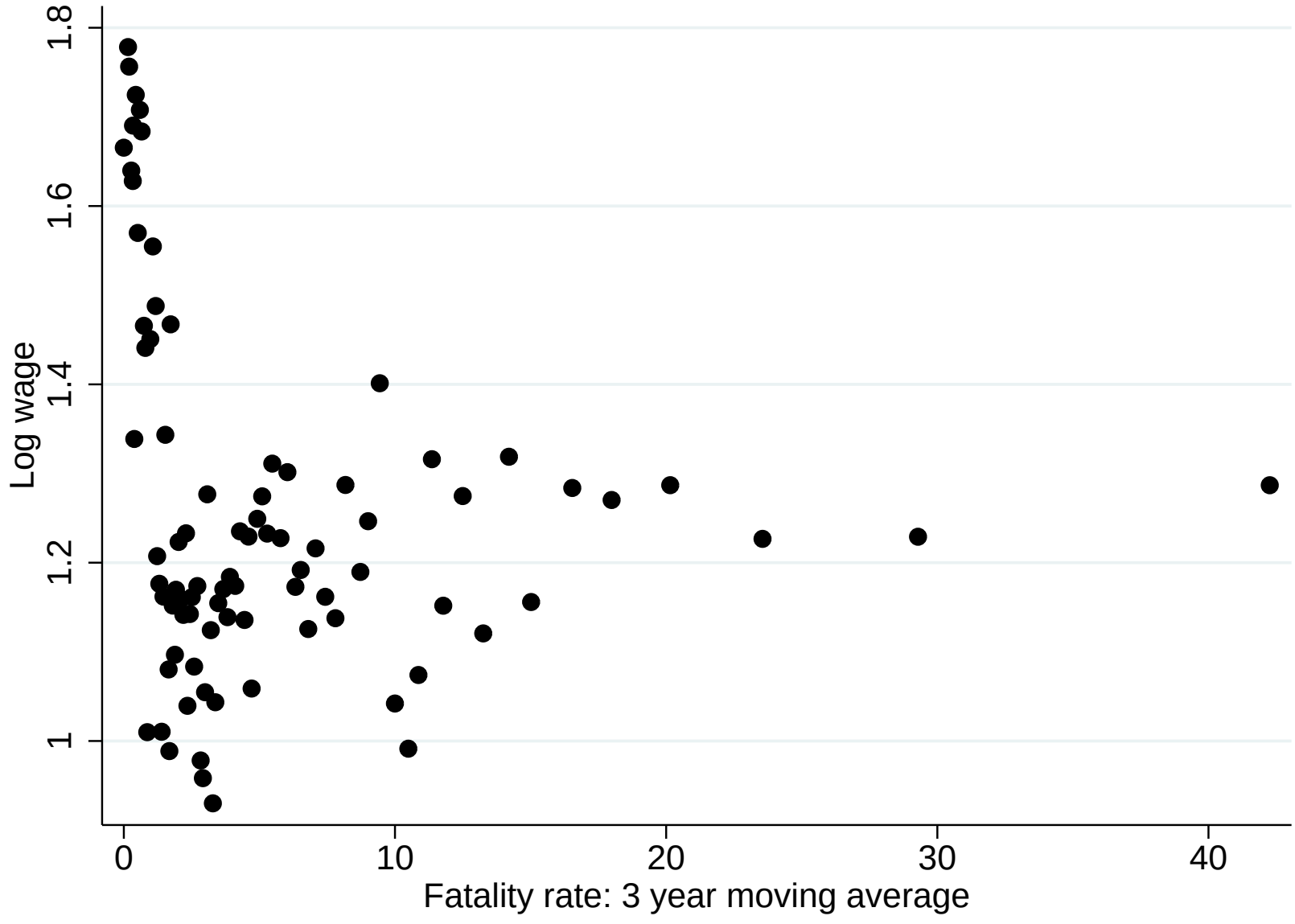


Implications of Misspecification



Fatality Rate versus Log Wage: Binned Scatterplot

Tests



Data

Longitudinal employer-employee data for Brazil: 2003-2010

- *Relação Anual de Informações Sociais* (RAIS)
- collected from plant managers for program administration
- covers all formal-sector jobs (50 million per year)

data items *all reported by employer*

- **job characteristics:**
  - wage, hours, occupation, date of hire
  - **CAUSE OF SEPARATION**, including
  - *Death on the job*
- **plant characteristics:** industry, size, location ...
- **worker characteristics:** age, education, race, sex ...

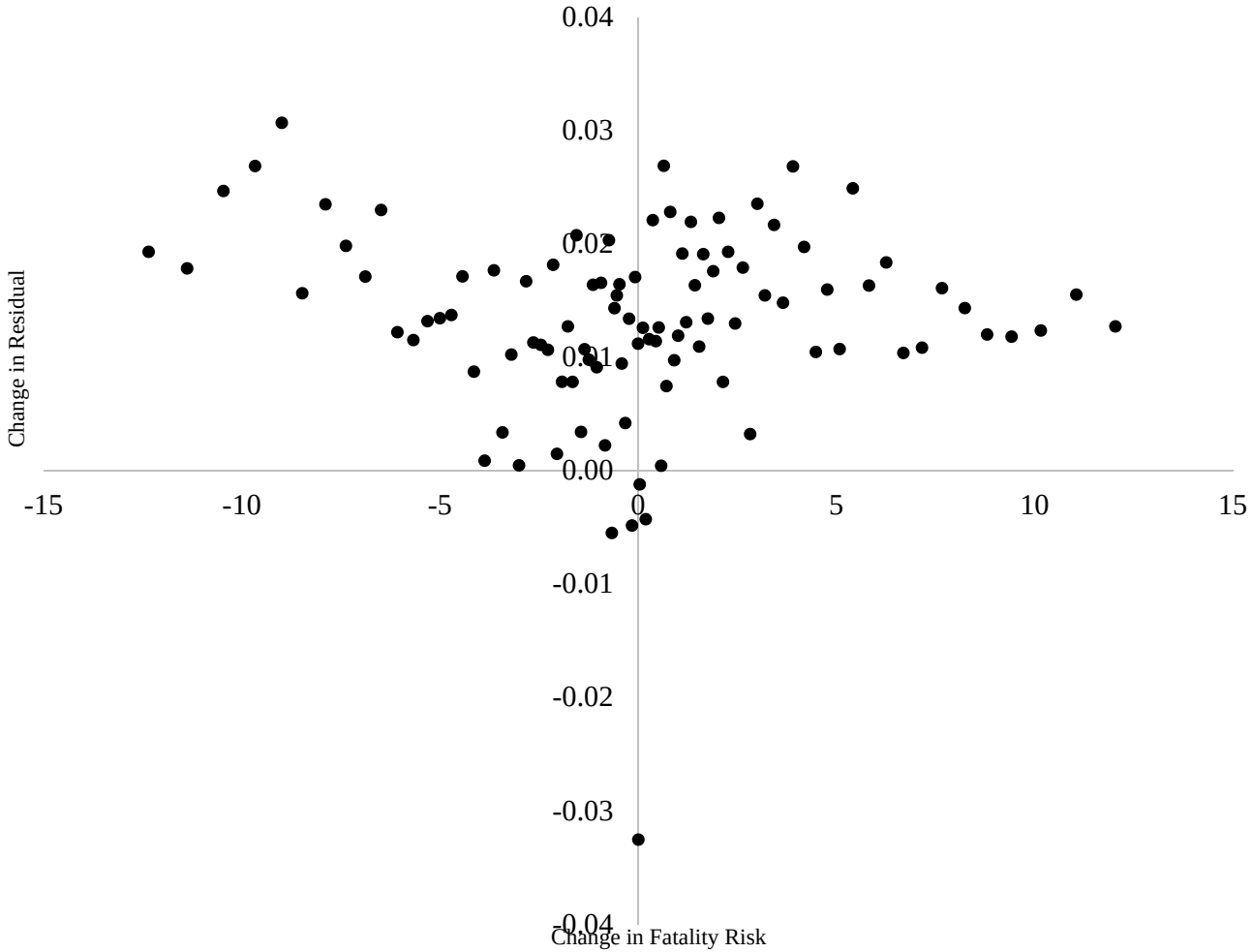
Analysis Data:

- Men age 23–60,employed full-time
- Dominant jobs only
- Exclude government and temporary contracts
- Populations
  - 83 million job-year observations
  - 30 million workers
  - 1 million plants

CWD for Full-Time Prime-Age Men

	Dependent Variable: $\ln(Wage)$	
	Pooled	Worker Effects
Fatality Rate (3-Yr MA)	0.363	0.041
	(0.001)	(0.001)
Zero Fatality Rate	0.070	0.009
	(0.000)	(0.000)
N	83,411,371	83,418,032
R-Sq	0.499	0.914
VSL (millions of reais)	2.85	0.32
95% CI	[2.83, 2.86]	[0.30, 0.33]

Figure: Average Change in Residual by Change in Fatality Rate



$$w_{it} = x_{it}\beta + \gamma_1 Risk_{c(i,t),t} + \Phi_{i,F(i,t)} + \epsilon_{it}$$

Second-stage dependent variable

$$\tilde{w}_{it} \equiv w_{it} - x_{it}\widehat{\beta}$$

Stage 2

$$\tilde{w}_{it} = \gamma_2 Risk_{c(i,t),t} + \theta_i + \psi_{F(i,t)} + \varepsilon_{it}$$

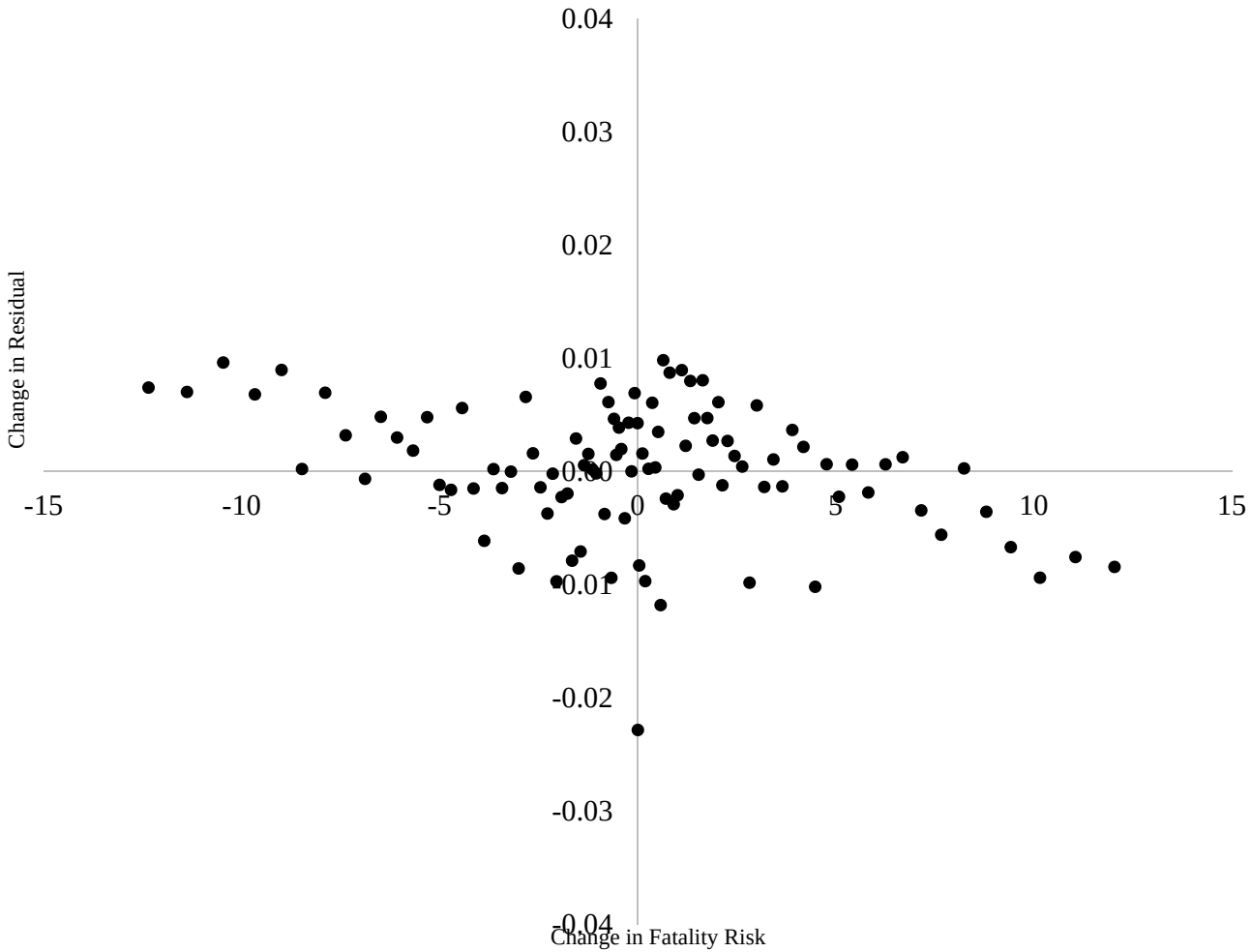
CWD for Full-Time Prime-Age Men

	Dependent Variable: $\ln(Wage)$			
	(1)	(2)	(3)	(4)
	Pooled	Worker Effects	Match Effects	Orth. Match Effects
Fatality Rate (3-Yr MA)	0.363*	0.041*	–0.004	0.490*
	(0.001)	(0.001)	(0.001)	(0.001)
Zero Fatality Rate	0.070*	0.009*	–0.006*	0.027*
	(0.000)	(0.000)	(0.000)	(0.000)
N	83,411,371	83,418,032	83,418,032	83,418,032
R-Sq	0.499	0.914	0.978	0.965
VSL (millions of reais)	2.85	0.32	-0.03	3.84
95% CI	[2.83, 2.86]	[0.30, 0.33]	[-0.05, -0.01]	[3.81, 3.86]

Residual Diagnostics: OME Model

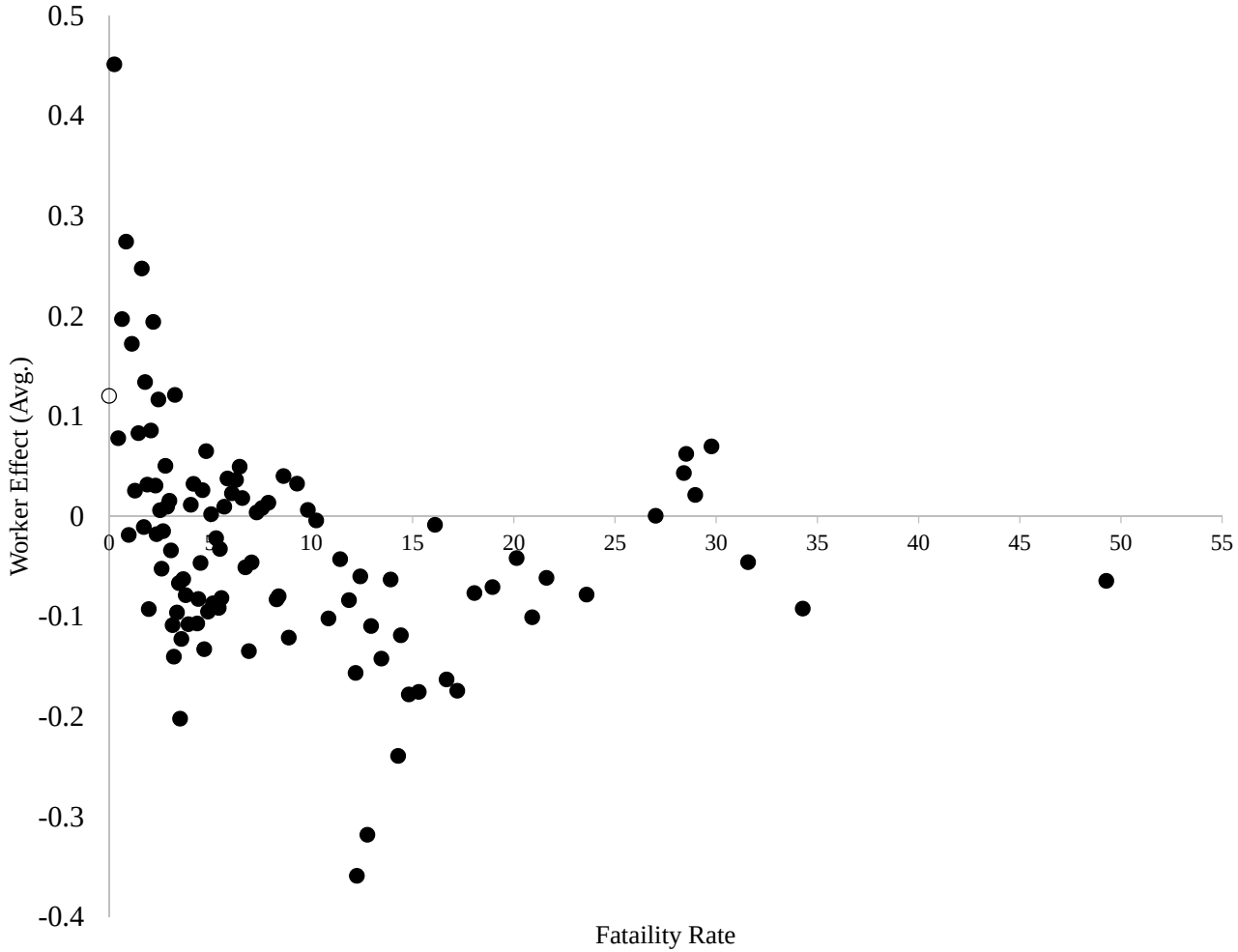
Worker Effect

Figure: Average Change in Residual by Change in Fatality Rate



Exogneity Diagnostics

Figure: Average Worker Wage Effect by Percentile of the Fatality Rate



▸ Intuition

Figure: Average Establishment Wage Effect by Percentile of the Fatality Rate

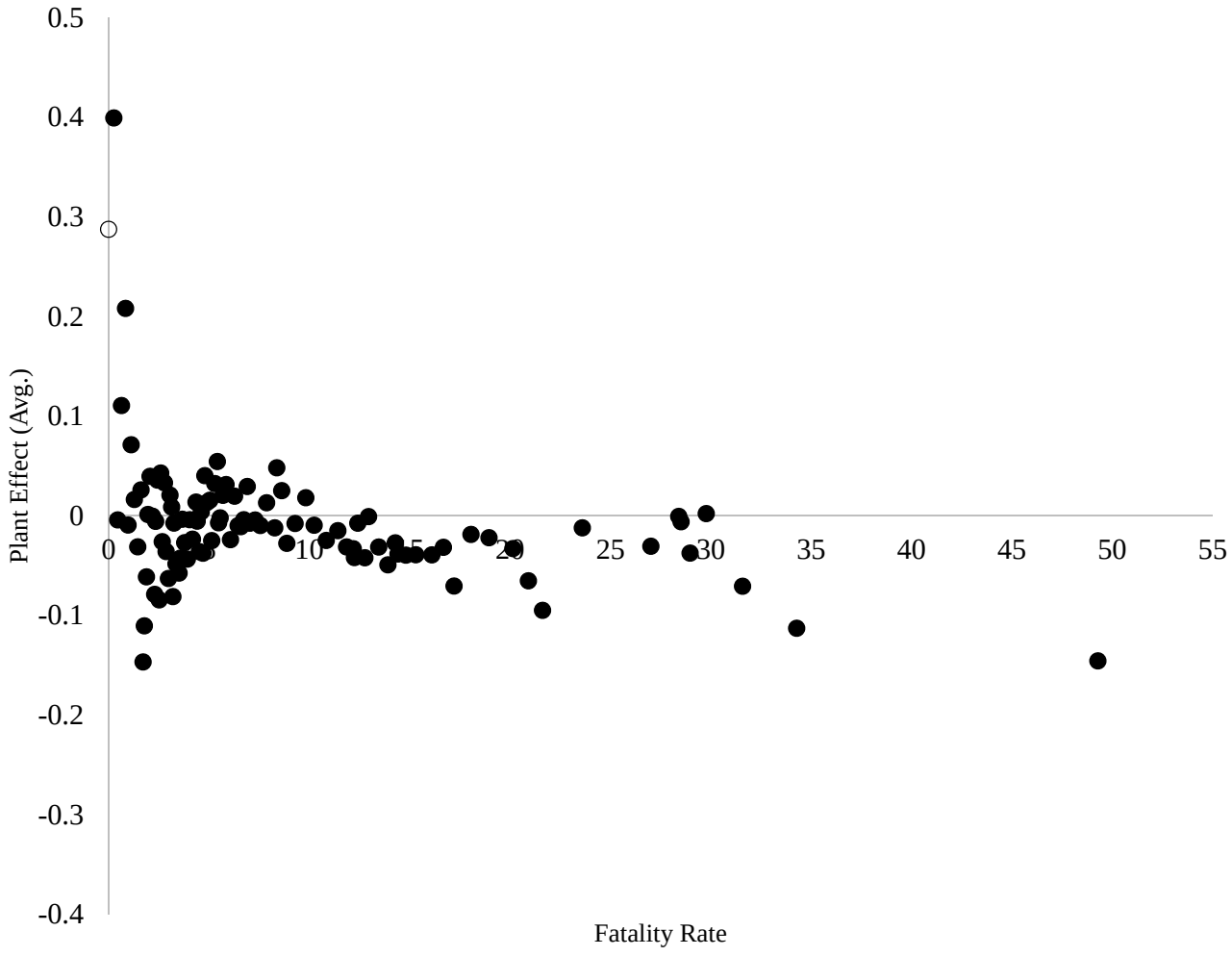


Figure: Worker Effects Model

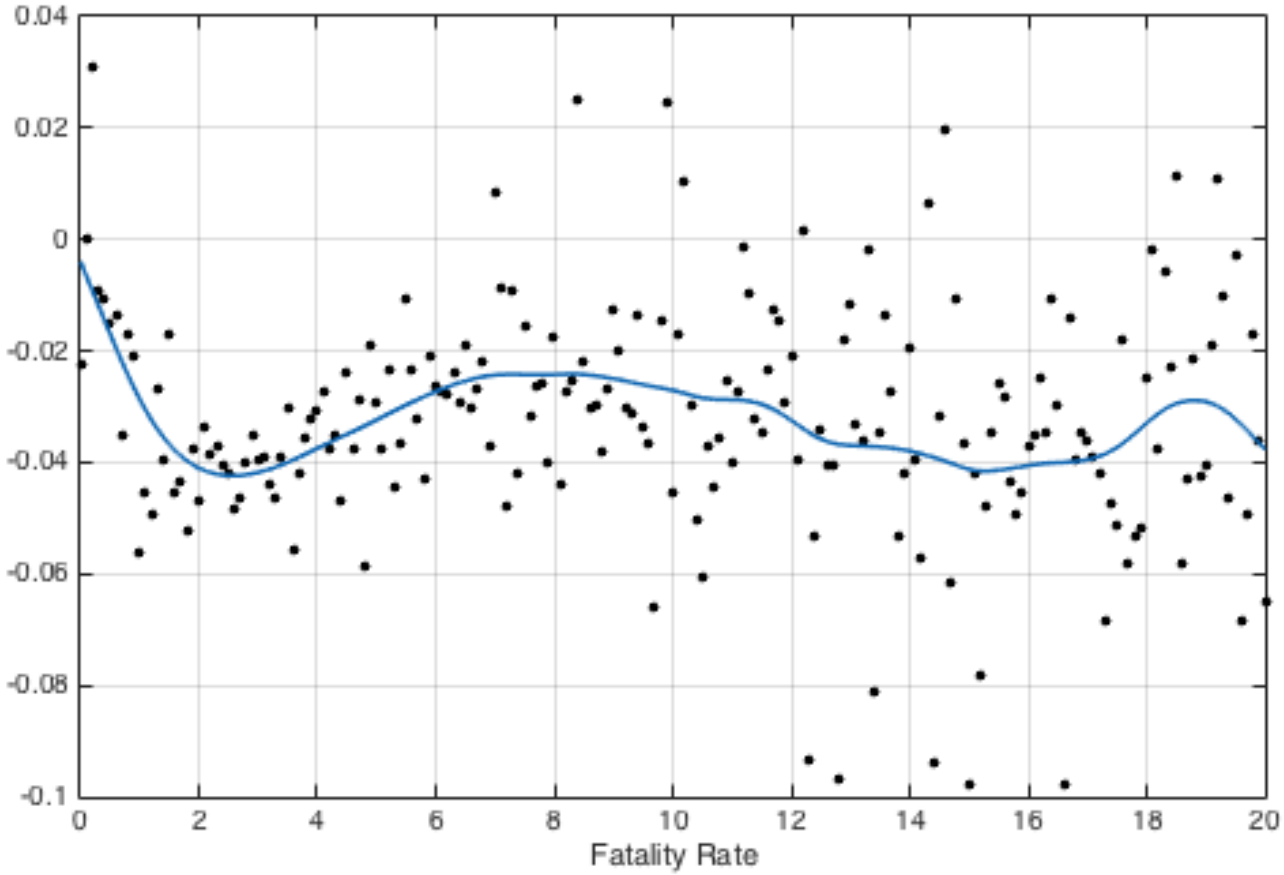
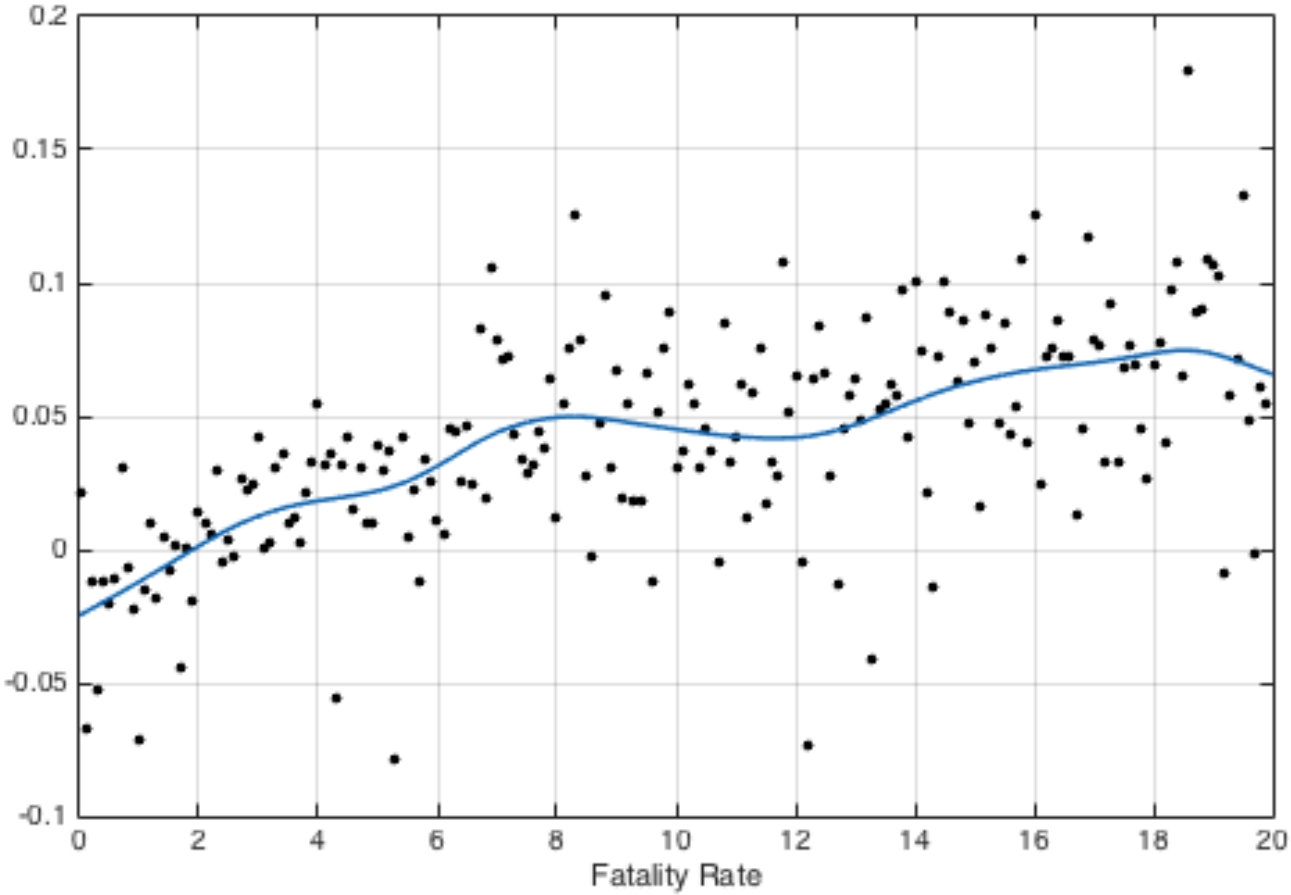


Figure: OME Model



Extensions

Mass Displacement

	Dependent Variable: $\ln(Wage)$			
	(1) Pooled	(2) Worker Effects	(3) Match Effects	(4) Orth. Match Effects
Fatality Rate (3-Yr MA)	0.525*	0.062*	–0.006	0.653*
	(0.001)	(0.001)	(0.002)	(0.002)
Fatality Rate × Mass Displacement	0.150*	0.048*		0.059*
	(0.004)	(0.003)		(0.004)
Zero Fatality Rate	0.084*	0.014*	–0.004*	0.039*
	(0.000)	(0.000)	(0.000)	(0.000)
Zero Fatality Rate × Mass Displacement	–0.008*	0.001		0.014*
	(0.001)	(0.001)		(0.001)
Mass Displacement	–0.015*	0.010*		–0.052*
	(0.000)	(0.000)		(0.001)
N	48,795,576	48,800,263	48,800,263	48,800,263
R-Sq	0.479	0.912	0.976	0.966

Relaxing the $E\left[R_{c(i,t)}\Phi_{i,J(i,t)}\right] = 0$ Condition

Construct instruments from

$$R^i = \{R_{ks+1} | s < t, k \neq i, k \in N(i,t)\}$$

- $N(i,t)$ is the set of 'neighbors' of i in the realized mobility network
- e.g. $\tilde{R}_{it} = \frac{1}{|N(i,t)|} \sum_{\ell \in R^i} R_\ell$
- We define $N(i,t)$ for each worker in each year as the set of former co-workers who worked at the same establishment and in the same occupation as worker i, and exited that job within the previous two years

IV Estimates

	(1) First-Difference	(2) with Estab Effects	(3) IV First Stage	(4) IV
ΔFatality Rate	-0.025	0.632*		0.508*
(3-Yr MA)	(0.016)	(0.010)		(0.034)
Avg. Δ Fat. Rate			0.336*	
in $N(i.t)$			(0.001)	
N	4,599,345	4,599,345	4,599,345	4,599,345

Other Extensions

- Heterogeneity by search frictions
- Job durations
- non-linear CWD

Conclusions

- Basic panel data estimators of the compensating wage differential for fatal risk are severely downward biased
- Using matched employer-employee data to control for establishment effects provides estimates that are very similar to IV estimates, and to job-to-job only estimates
- Under certain empirical conditions on the level of variation in wages, the parameter estimate from the fixed effects model is equal to the marginal willingness to accept fatal risk, even under some forms of search friction
  - Key is that the dimensions over which workers are comparing jobs in the search model must be included in the empirical model
  - This was not previously possible with typical panel data

Thank You.

Ian M. Schmutte
(schmutte@uga.edu)

Bonus Slides

Causes of Job Separation

Value	Label Portuguese	Label English
0	nao desl ano	no separation this year
10	dem com jc	terminated with just cause
11	dem sem jc	terminated without just cause
12	term contr	end of contract
20	desl com jc	resigned with just cause
21	desl sem jc	resigned without just cause
30	trans c/onus	xfer with cost to firm
31	trans s/onus	xfer with cost to worker
40	mud. regime	Change of labor regime
50	reforma	military reform - paid reserves
60	falecimento	demise, death
62	falec ac trb	death - at work accident
63	falec ac tip	death - at work accident corp
64	falec d prof	death - work related illness
70	apos ts cres	retirement - length of service with contract termination
71	apos ts sres	retirement - length of service without contract termination
72	apos id cres	retirement - age with contract termination
73	apos in acid	retirement - disability from work accident
74	apos in doen	retirement - disability from work illness
75	apos compuls	retirement - mandatory
76	apos in outr	retirement - other disability
78	apos id sres	retirement - age without contract termination
79	apos esp cre	retirement - special with contract termination
80	apos esp sre	retirement - special without contract termination

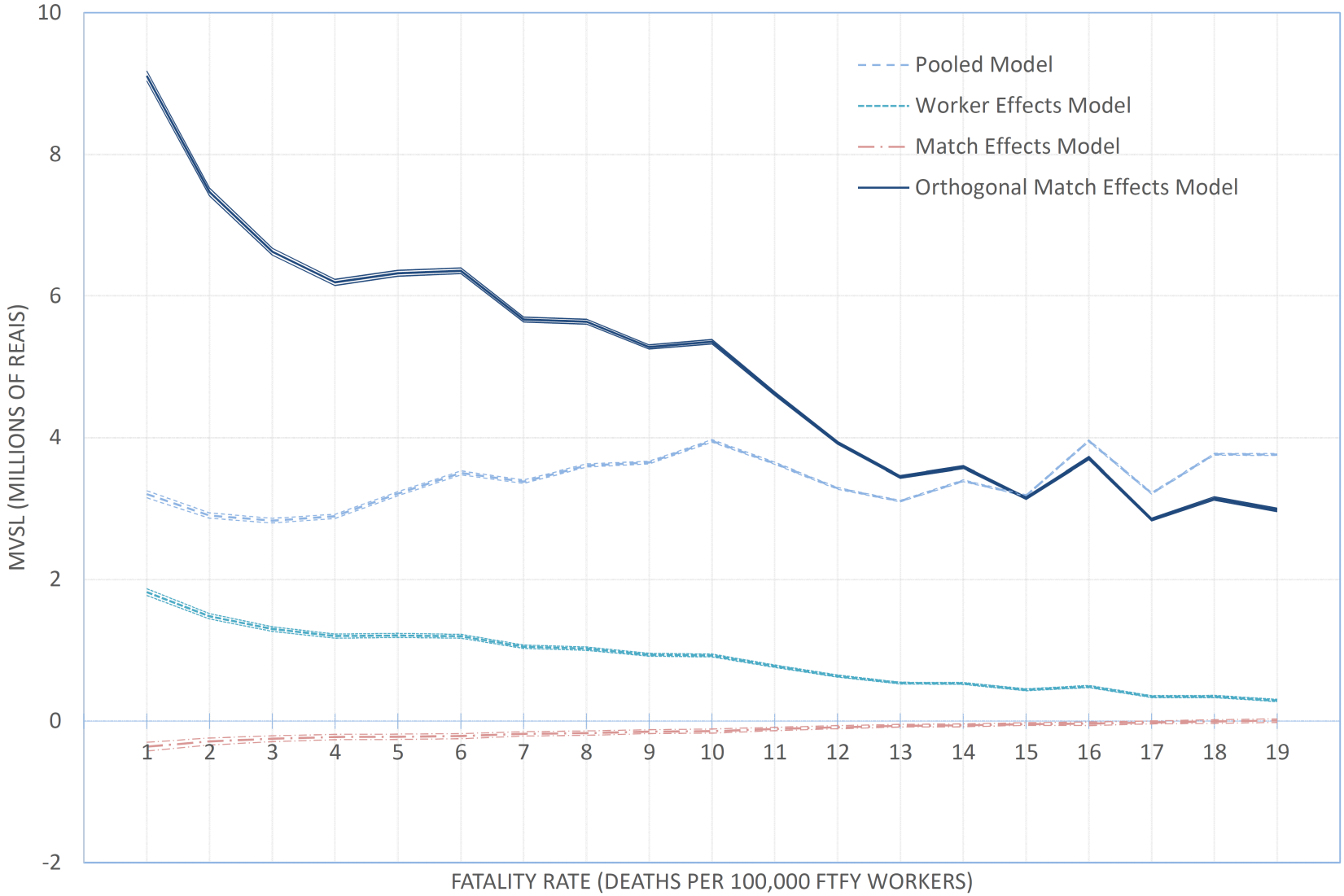
Summary Statistics

	Population	Analysis Sample
Age	36.98	36.23
Race *branco* (White)	0.56	0.58
Elementary or Less	0.40	0.40
Some High School	0.09	0.10
High School	0.36	0.39
Some College	0.04	0.04
College or More	0.11	0.07
Contracted Weekly Hours	42.19	43.34
Log Hourly Wage	1.47	1.37
Total Experience (Years)	20.58	19.86
Job Tenure (Months)	58.70	44.28
Fatality Rate (per 100,000)	7.14	8.29
Zero Fatality Rate (Percent)	0.14	0.09
Number of Observations	158,254,802	83,418,032

Average Fatality Rates

Industry	Average Fatality Rate	Number of Job-Years
Agriculture and Fishing	10.25	22,762,420
Mining	10.48	1,814,957
Manufacturing	5.24	76,712,576
Utilities	4.19	2,023,931
Construction	13.77	26,098,278
Trade and Repair	6.04	82,004,063
Food, Lodging, and Hospitality	4.99	15,589,304
Transportation, Storage, and Communication	14.53	20,941,098
Financial and Intermediary Services	1.01	6,947,728
Real Estate, Renting, and Services	4.59	57,447,503
Public Administration, Defense, and Public Security	0.84	72,055,976
Education	1.58	12,418,485
Health and Social Services	1.67	14,089,834
Other Social and Personal Services	3.98	15,469,519
Domestic Services	5.76	116,086
Occupation		
Public Administration and Management	2.63	18,035,409
Professionals, Artists, and Scientists	1.09	39,178,629
Mid-Level Technicians	2.50	40,972,375
Administrative Workers	1.87	78,792,943
Service Workers and Vendors	4.40	98,796,568
Agriculture Workers, Fishermen, Forestry Workers	9.26	25,417,204
Production and Manufacturing I	11.65	94,955,794
Production and Manufacturing II	5.28	15,947,072
Repair and Maintenence Workers	7.39	13,871,753

Additional Results - Cubic in Fatality Rate



Separation Models

	Dependent Variable: Separation			
	(1)	(2)	(3)	(4)
	Logistic	Logistic	Lin. Prob.	Lin. Prob.
Fatality Rate (3-Yr MA)	0.224*	0.291*	0.040*	-0.021*
	(0.021)	(0.020)	(0.004)	(0.002)
Zero Fatality Rate	-0.003	0.015	0.004*	0.002*
	(0.006)	(0.006)	(0.001)	(0.000)
Log Wage	-0.070*	–	–	–
	(0.001)			
Worker Effect	–	-0.455*	-0.055*	-0.060*
		(0.005)	(0.001)	(0.001)
Estab. Effect	–	-0.121*	-0.032*	–
		(0.009)	(0.000)	
Tenure	-1.093*	-0.603*	-0.015*	-0.019*
	(0.010)	(0.013)	(0.001)	(0.001)
Plant Effects	N	N	N	Y
N	83,411,371	83,411,371	83,411,371	83,411,371
(Pseudo) R-Sq	0.071	0.076	0.065	0.1478

Heterogeneity in Market Friction

	Dependent Variable: $\ln(Wage)$			
	(1)	(2)	(3)	(4)
	Pooled	Worker Effects	Match Effects	Orth. Match Effects
1st Quintile Variance Estab. Effects*Fatality Rate	0.505*	0.044*	–0.019*	0.449*
	(0.001)	(0.002)	(0.003)	(0.003)
2nd Quintile Variance Estab. Effects*Fatality Rate	0.452*	0.033*	–0.053*	0.492*
	(0.001)	(0.002)	(0.003)	(0.003)
3rd Quintile Variance Estab. Effects*Fatality Rate	0.390*	0.035*	0.012*	0.469*
	(0.001)	(0.002)	(0.003)	(0.003)
4th Quintile Variance Estab. Effects*Fatality Rate	0.144*	0.054*	0.049*	0.557*
	(0.001)	(0.002)	(0.003)	(0.003)
5th Quintile Variance Estab. Effects*Fatality Rate	0.293*	0.035*	–0.023*	0.485*
	(0.002)	(0.003)	(0.004)	(0.004)
N	83,411,371	83,418,032	83,418,032	83,418,032
R-Sq	0.500	0.914	0.978	0.965
1st Quintile Wage Elasticity of Job Sep.*Fatality Rate	0.029*	-0.074*	–0.031*	0.348*
	(0.001)	(0.002)	(0.003)	(0.002)
2nd Quintile Wage Elasticity of Job Sep.*Fatality Rate	0.168*	-0.032*	0.025*	0.346*
	(0.001)	(0.001)	(0.002)	(0.002)
3rd Quintile Wage Elasticity of Job Sep.*Fatality Rate	0.244*	0.080*	0.125*	0.499*
	(0.001)	(0.001)	(0.002)	(0.002)
4th Quintile Wage Elasticity of Job Sep.*Fatality Rate	0.409*	0.047*	0.031*	0.477*
	(0.001)	(0.001)	(0.003)	(0.002)
5th Quintile Wage Elasticity of Job Sep.*Fatality Rate	0.665*	0.141*	–0.186*	0.370*
	(0.001)	(0.002)	(0.003)	(0.002)
N	83,411,371	83,418,032	83,418,032	83,418,032
R-Sq	0.500	0.914	0.982	0.963